WHAT IS CLAIMED IS:

1. A monolithic semiconductor optical device comprising:

a common semiconductor substrate configured to have an electric absorption modulator formation area and a DFB laser formation area;

an electric absorption modulator (EA modulator) formed in the electric absorption modulator formation area and having an aluminum-based EA modulator active region; and

a distributed feedback laser device (DFB laser) formed in the DFB laser formation area and having a non-aluminum-based DFB laser active region.

2. The monolithic semiconductor optical device according to claim 1, wherein:

the EA modulator active region is configured to be quantum wells and comprises an A1GaInAs-based material.

3. The monolithic semiconductor optical device according to claim 2, wherein:

the EA modulator active region is configured to be at least a couple of an SCH (Separate Confinement Heterostructure) and comprises an A1GaInAs-based material.

4. The monolithic semiconductor optical device according to claim 2, wherein:

the DFB laser active region is configured to be a quantum well and comprises a GaInAsP-based material.

5. The monolithic semiconductor optical device according to claim 1, wherein:

the EA modulator active region is configured to be wider than the DFB laser active region.

6. The monolithic semiconductor optical device according to claim 4, wherein the EA modulator comprises:

at least one of a buried ridge structure or a self aligned structure (SAS).

7. The monolithic semiconductor optical device according to claim 6, wherein the EA modulator comprises:

an optical waveguide stripe layer comprising at least one of a GaInAsP or AlGaInAs layer in an upper cladding layer.

8. The monolithic semiconductor optical device according to claim 6, wherein the EA modulator comprises:

A1GaInAs layer configured as an SCH-MQW and as an etchant stop.

9. The monolithic semiconductor optical device according to claim 1, wherein:

the DFB laser comprises a semi-insulating buried heterostructure GaInAsP-based DFB laser; and

the EA modulator comprises a buried ridge type AlGaInAs-based EA modulator.

10. The monolithic semiconductor optical device according to claim 1, wherein:

the DFB laser comprises a semi-insulating planar buried heterostructure GaInAsP-based DFB laser; and

the EA modulator comprises a self aligned structure (SAS) AlGaInAs-based EA modulator.

11. A monolithic semiconductor optical device comprising:

a common substrate having an electric absorption modulator formation area and a DFB laser formation area;

an A1GaInAs-based quantum well electric absorption modulator (EA modulator) formed in the electric absorption modulator formation area;

a quantum well structure distributed feedback laser device (DFB laser) formed in the DFB laser formation area;

means for generating a coherent light; and

means for modulating the coherent light at a modulation rate greater than 10 GHz.

12. A method for fabricating a monolithic semiconductor optical device comprising steps of:

providing a common substrate having a modulator formation area and a laser formation area; and

sequentially forming on the common substrate one of a multilayer EA modulator with an aluminum-based active region and a multilayer DFB laser with a non-aluminum-based active region and the other of the multilayer EA modulator and a multilayer DFB laser.

13. The method as defined in claim 12, wherein said sequentially forming step comprises substeps of:

forming one of the EA modulator and the DFB laser step across the common substrate to form a first stacked structure;

etching the first stacked structure, wherein said etching step is configured to create a second stacked structure and to expose a portion of the substrate, wherein the portion of the substrate selectively corresponds to one of the laser formation area and the modulator formation area;

forming on the exposed portion of the substrate the other of the DFB laser and the EA modulator, wherein said forming on a portion of the substrate is configured to form a third stacked structure; and

forming a mesa stripe by simultaneously etching the second stacked structure and third stacked structure.

14. The method as defined in claim 13, wherein the step of forming a mesa stripe comprises:

a substep of dry etching.

15. The method as defined in claim 14, wherein said substep of dry etching comprises a substep of:

etching with one of a methane-based and a bromine-containing etchant in a chamber of a film-forming apparatus.

16. The method as defined in claim 12, further comprising a step of:

burying the mesa stripe with at least one semi-insulating InP layer, wherein said burying step is configured to form a BH structure in the DFB laser formation area and at least one of a buried ridge structure and an SAS structure in the EA modulator formation area .